



CMMI v1.1 Overview

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CMMI Program Manager

CMMI Technology Conference

14 Nov 01

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Agenda

- CMMI V1.0 – What has been learned?
- CMMI V1.1 – What changes?
- CMMI – What is next?
- Q&A



CMMI Design Goals and Benefits

Design Goals

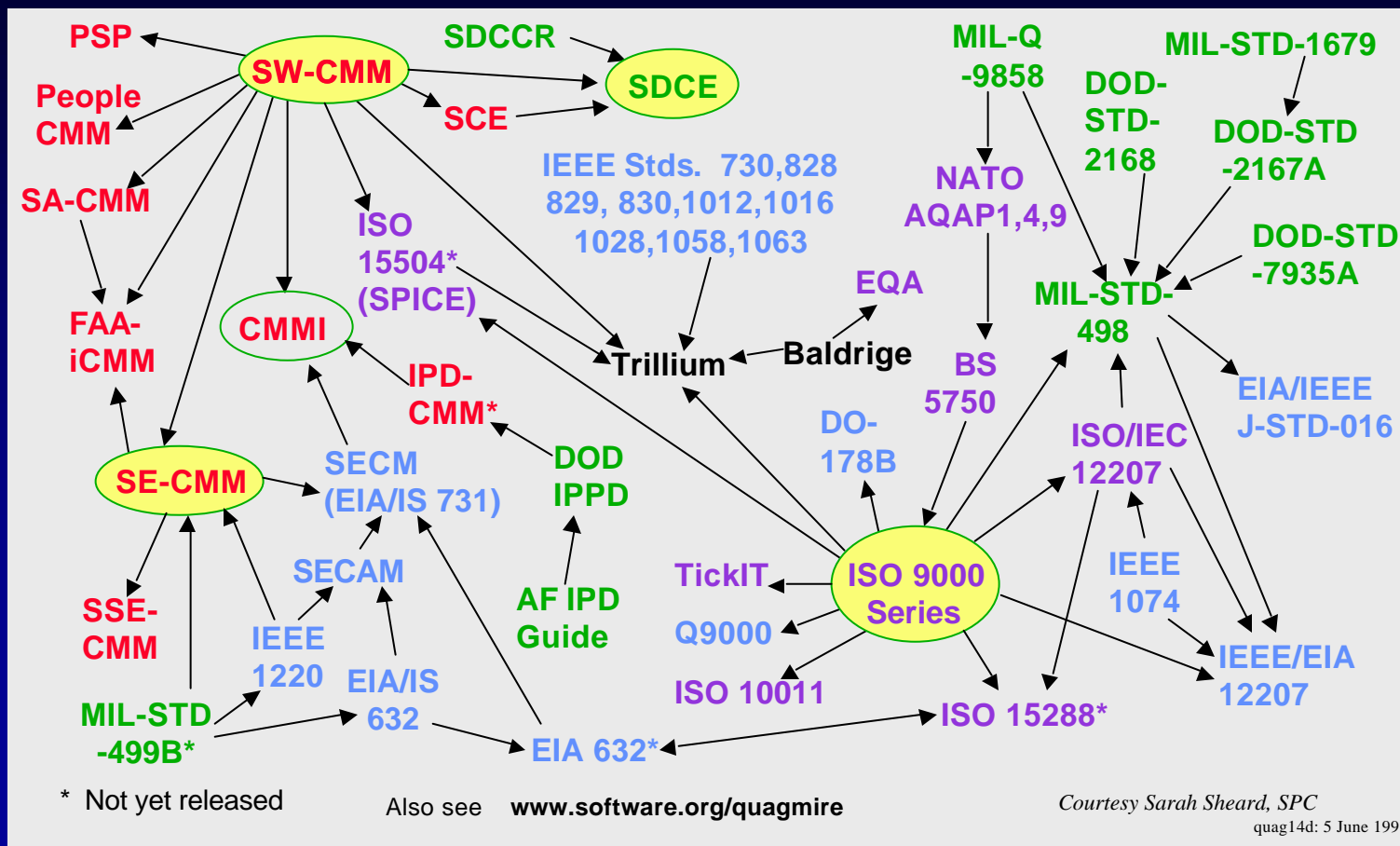
- Integrate the source models, eliminate inconsistencies, reduce duplication
- Reduce the cost of implementing model-based process improvement
- Be sensitive to impact on legacy efforts

Benefits

- Efficient, effective assessment and improvement across multiple process disciplines
- Reduced training and assessment costs
- A common, integrated vision of improvement for all elements of an organization
- **Integration of systems engineering and software environments for additional productivity & quality gains**



The Frameworks Quagmire (before)



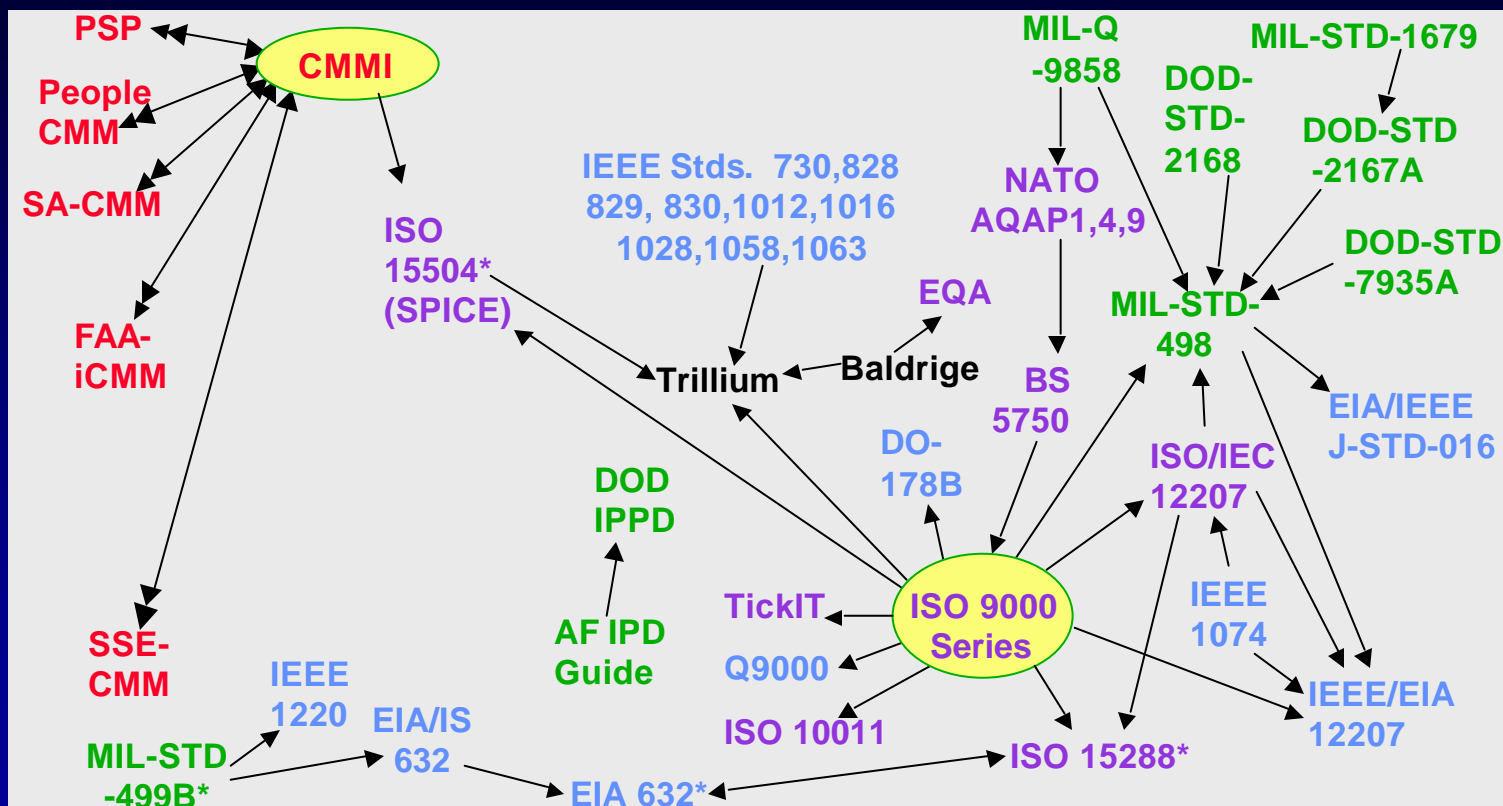
* Not yet released

Also see www.software.org/quagmire

Courtesy Sarah Sheard, SPC

quag14d: 5 June 1998

The Frameworks Quagmire (now)



* Not yet released

Also see www.software.org/quagmire

quag14d: 5 June 1998



Discoveries in Use

Assessment time shows an excellent learning curve

- **40% reduction in assessment time over five Australian assessments**

“Shadow assessments” show ease of transition

- **High maturity CBA IPI at Litton PRC**
- **Multiple EIA/IS 731 Systems Engineering assessments**

Mappings and gap analyses confirm evolutionary expansion from predecessor models

- **Government and contractors agree on CMMI’s improved engineering coverage in contract monitoring**



Pilot Results

Six SCAMPs accomplished against V1.02

- 6-12 assessment team members
- All explored continuous representation
- 2 government, 4 industry
- 2-4 Projects
- 15-21 Interviews

Total on-site hours ranged from 85-137 hours

- All went beyond SE/SW
- “Equivalent” hours: 77-120; median 92



Pilot Results: What worked well

Breadth first assessment of Generic Practices

Incremental/continuous consolidation

Effective strategy for initial and follow-up interviews

Prior preparation of interview questions



High Maturity Workshop CMMI Session Summary

- Level of **impact and effort in a high maturity organization** should be minimal due to natural extension from SW CMM to CMMI.
- **CMMI can be especially beneficial to organization with less mature SE groups.**
- CMMI provides commonality in process improvement across Software and Systems engineering disciplines. [Approval may be at Engineering VP.]
- Basically **CMMI has broadened the base.** Implementation has to do with size of the organization.



Value of CMMI

Better incorporates engineering principles that are critical to software intensive systems – and “systems of systems”

Integrated Appraisal Method (Ver. 1.1) will provide a single, consistent method for both internal assessments and external evaluations

Reduces cost of a SW and SE appraisal



CMMI Schedule

December 2000

- CMMI-SE/SW v1.02, CMMI-SE/SW/IPPD v1.02 (initial use versions)
- CMMI-SE/SW/IPPD/A v1.02d (draft for initial piloting)

January 2002

- CMMI-SE/SW v1.1, CMMI-SE/SW/IPPD v1.1 (full use versions)

Spring 2002

- CMMI-SE/SW/IPPD/A v1.1 (full use version)
- V1.1 model and method training

December 2003

Complete sunset period
for SW-CMM, EIA/IS 731 (No more public courses, new
lead assessors)

December 2005

CMM Transition Partner Licenses end



Early Adopters

Carnegie Mellon
Software Engineering Institute

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Who we are
and
What we do

ABOUT THE SEI

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- [Product Suite](#)
- [Project Groups](#)
- [Organizing Documents](#)
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CMMI Early Adopters

The organizations listed below were some of the first to implement CMMI-based process improvement initiatives. If the organization's listing includes an individual's name, that person may be contacted to answer questions or share lessons learned from his or her experiences with CMMI programs.

The Boeing Company
Al Brown
World Wide Web: <http://www.boeing.com>

Harris Corporation
Gary Natwick, Senior Principal Engineer
E-mail: gnatwick@harris.com
World Wide Web: <http://www.harris.com>

**Jacobs/Sverdrup Technology Inc., Advanced Systems Group
Engineering Performance Improvement Center (EPIC)**
Jeffrey L. Dutton, Technical Director
E-mail: duttonjl@sverdrup.com

U.S. Army TACOM-ARDEC Software Enterprise
S. Wayne Sherer, Senior Technical Associate for Corporate Process Improvement
E-mail: wscherer@pica.army.mil

If you have questions or comments, send email to: webmaster@sei.cmu.edu



Current ROI Value to Programs

A report by Dod Data & Analysis Center for Software (DACS) found:

Application of SPI to “Example organization with example projects”:

Development costs	Reduced 73%
Rework costs	Reduced 96%
Average schedule length	Reduced 37%
Post-release defects	Reduced 80%
Weighted risk likelihood	Reduced 92%
Return on investment	21:1

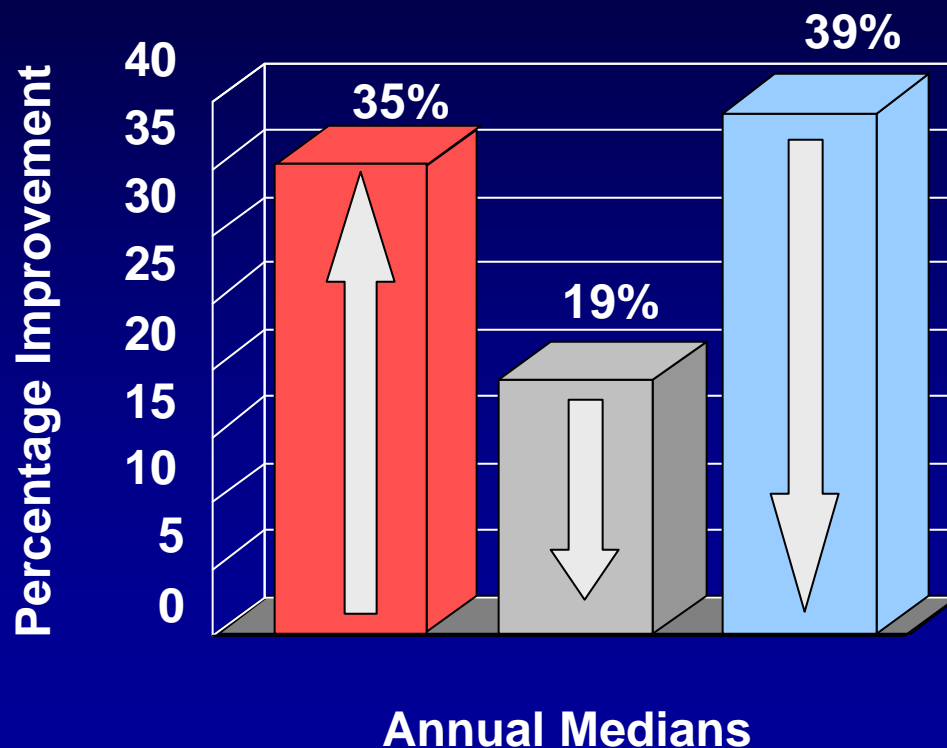
-A Business Case for SPI Revised

- Measuring ROI from Software Engineering and Management DACS, September 1999

see <http://www.dacs.dtic.mil/techs/roispi2/>



Improvements from Adopting SW-CMM



**Savings vs. cost of
software process
improvement (median)
5:1**

- Productivity (increase)
- Time to market (reduction)
- Post-release defect reports (reduction)



Benefits of Continuing Process Improvement

SEI SW-CMM Level 5: For the Right Reasons*

Defects are now nearly all found and fixed before testing begins.

Defects escaping into the field have been reduced from 11% to practically 0%.

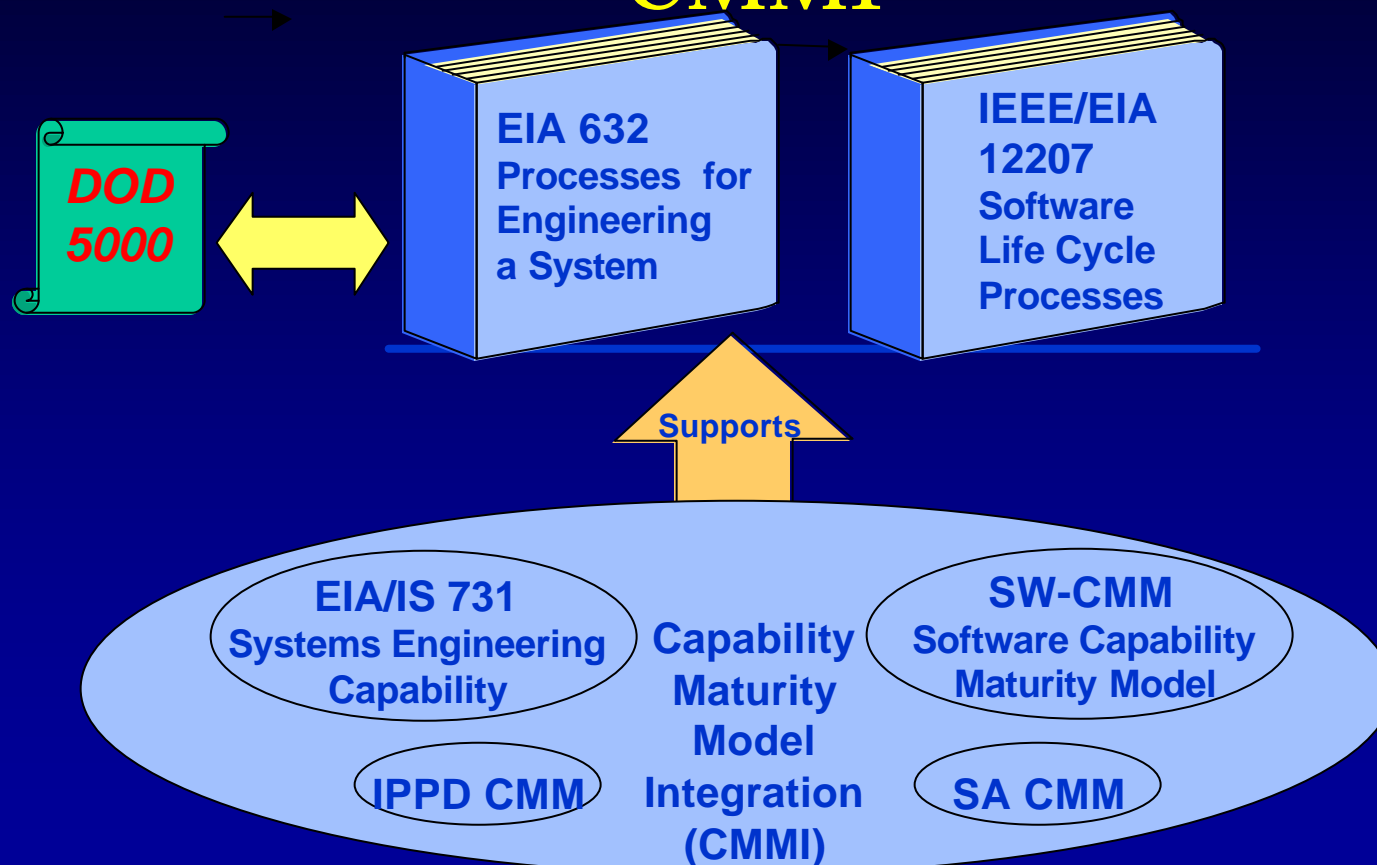
Programs consistently reach customer satisfaction and performance targets.

Peer reviews increase total project costs by 4%, but reduced rework during testing by 31%. R.O.I. is 7.75:1.

* Reference: Yamamura and Wigle, Boeing Space and Transportation Systems, *Crosstalk*, Aug, 1997.

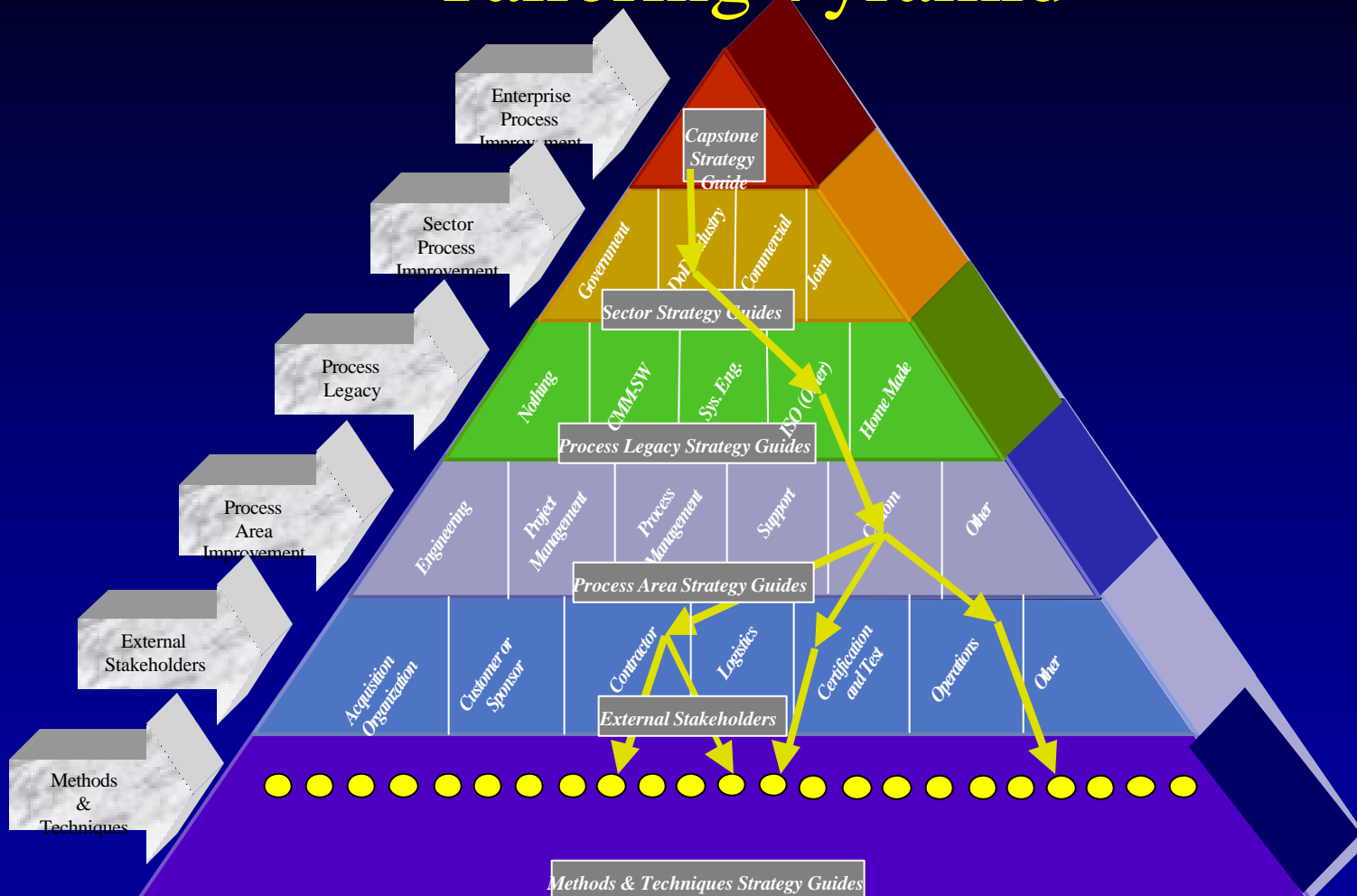


Systems Engineering Guidelines and CMMI





Tailoring Pyramid





V1.1 – What changes?

Model changes focused on consistency in terminology

Training changes match model changes, improve training clarity

Method changes more profound:

- External evaluations join internal assessments in method coverage
- Emphasis moves from “discovery” to “validation”
- Detailed coverage moves documentation from “description” to “definition”



Model changes – 1

Changes driven by:

- Change Request submitted from multiple sources
 - Public Review
 - Training course participants
 - CMMI Pilots
- Peer and CCB reviews

Changes focused on terminology, informative material

Architecture issues (representations, PA additions/deletions, advanced practices) were excluded from change



Model changes -- 2

Terminology rigorously reviewed and updated

- “Plan” versus “strategy”
- “Process” versus “process area”
- “Assessment” versus “appraisal”

Consistent use of “mischievous” terms

- “process capability”
- “life cycle”
- “senior management”

Equivalence between representations clarified

Attention to “architecture” and “design” practices increased



CMMI – What is next?

Emphasis through 2003 is on adoption/transition from legacy models

- Quarterly transition workshops will augment and compliment annual User Workshop
- “Communities of Practice” will be encouraged
 - Course instructors
 - CMMI Appraisers
 - Transition Implementation Teams

“Technical Notes” and “Special Reports” will compliment V1.1 Product Suite:

- Managing COTS integration
- Making attribute tradeoffs in design
- Mapping CMMI with other standards and models
- Adding prototypical coverage for specific interests (e.g., safety, security)



For More Information About CMMI

- Go to CMMI Website
 - <http://www.sei.cmu.edu/cmmi>
 - <http://www.sei.cmu.edu/cmmi/products/public-release.html>
- Contact SEI Customer Relations
 - Customer Relations
 - Software Engineering Institute
 - Carnegie Mellon University
 - Pittsburgh, PA 15213-3890
 - FAX: (412) 268-5800
 - customer-relations@sei.cmu.edu



Internet Sources

<http://www.sei.cmu.edu/cmmi/>

<http://seir.sei.cmu.edu/seir/>

<http://jo.sei.cmu.edu/pub/english.cgi/0/323123>



Additional Information

Charts of potential use in CMMI process improvement efforts



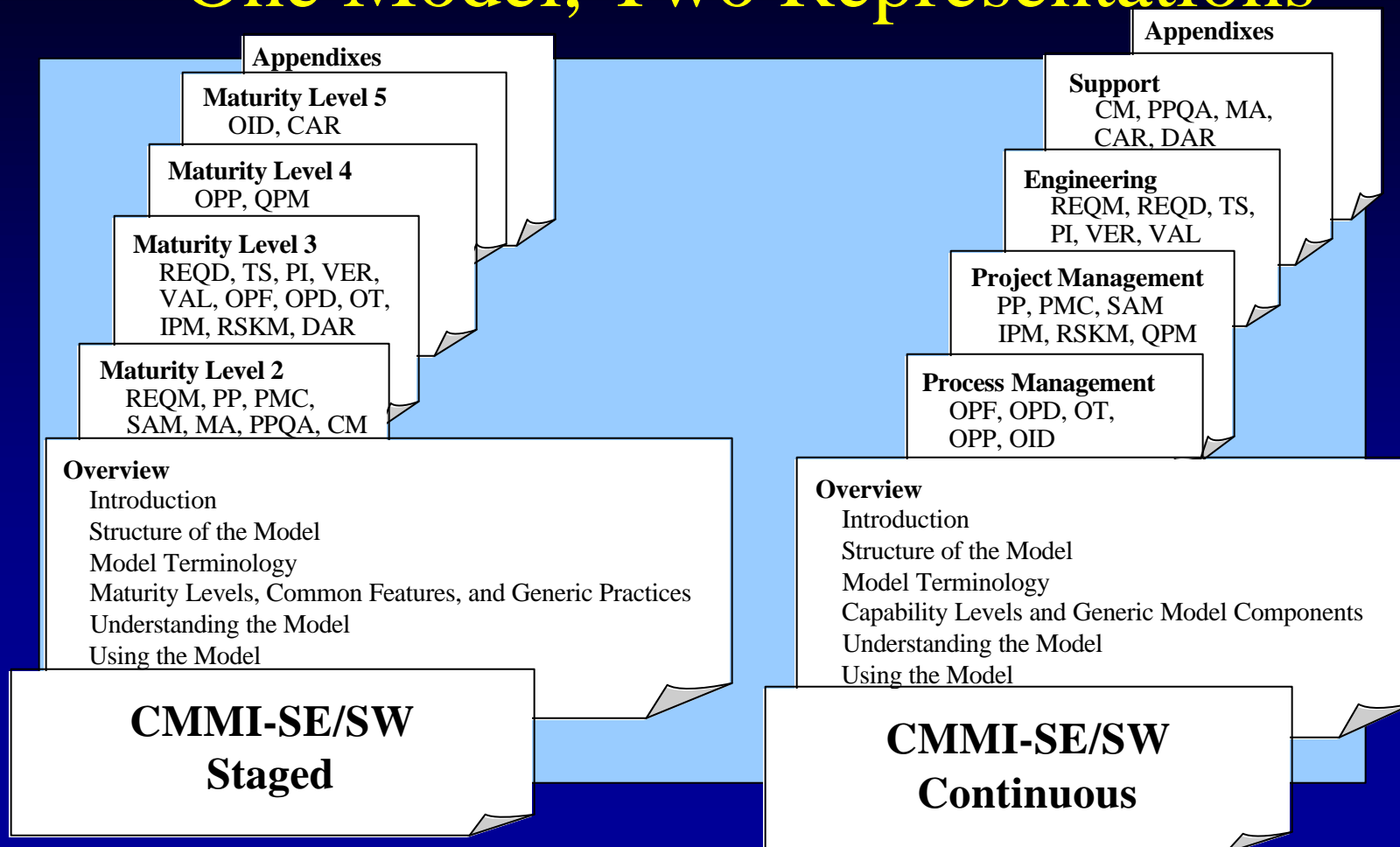
CMMI Policy

The OSD CMMI Sponsors, at Steering Group recommendation and with Industry sponsor concurrence, have established the sunset schedule for the SW-CMM legacy model (SW-CMM v1.1) to be three years after formal release of CMMI-SE/SW/IPPD, which occurred in December 2000. The Electronic Industries Association G47, owners of EIA/IS-731, have also agreed to this sunset policy and schedule for that source document. The CMMI **source model sunset** will therefore occur in **December, 2003**.

In order to provide additional refinement and update based on the continuing CMMI pilot program while maintaining the overall stability of the Product Suite, CMMI v1.1 is planned for release later this year. The minor product suite update will include the **provision for external evaluations using the CMMI models** as well as assessments for internal process improvement.



One Model, Two Representations





DoD Policy

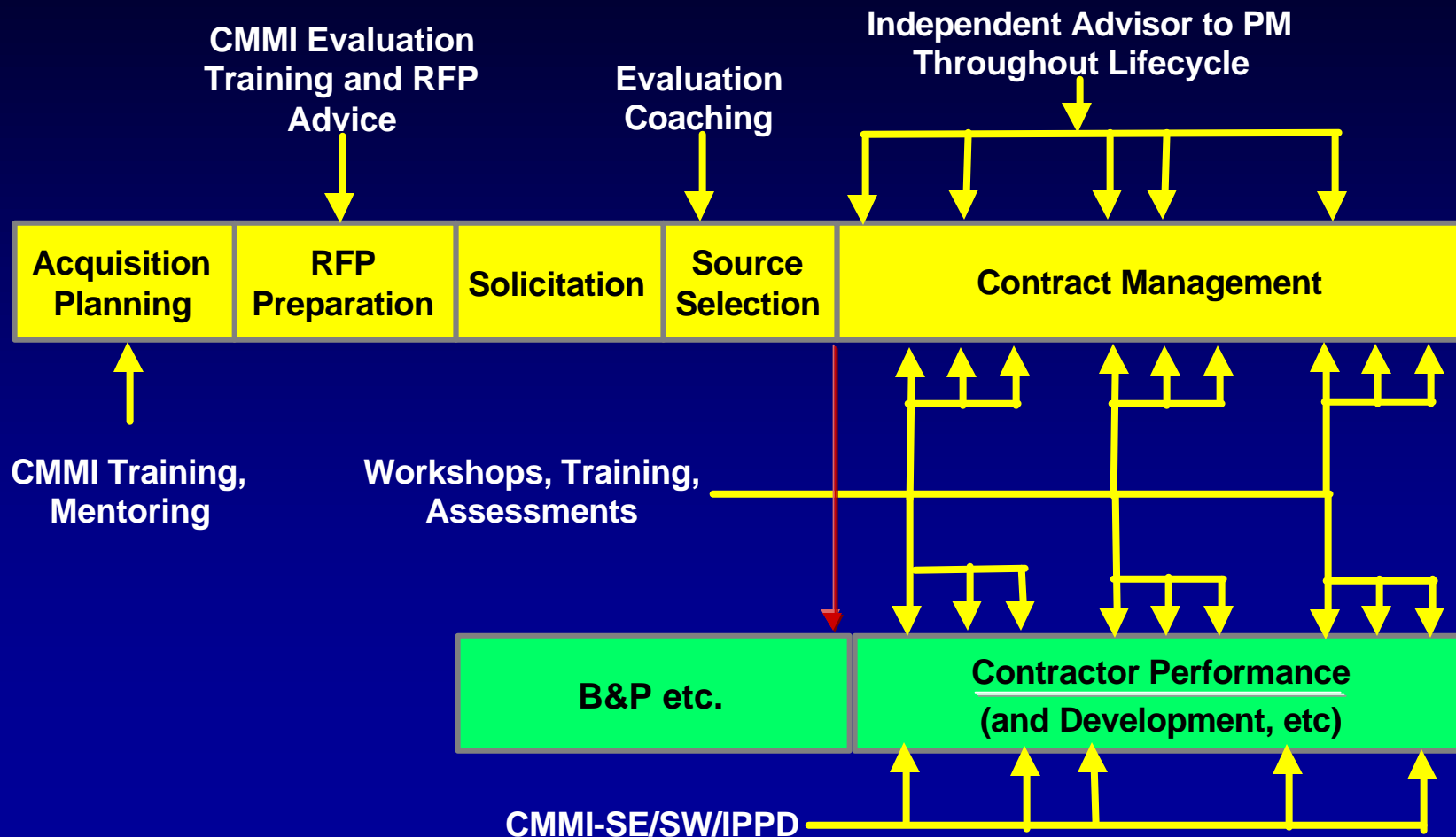
Revision to the “Gansler Memo” of Oct 99 under consideration

Intent to move from “software only” to “software and systems engineering” declared

Policy release by December planned

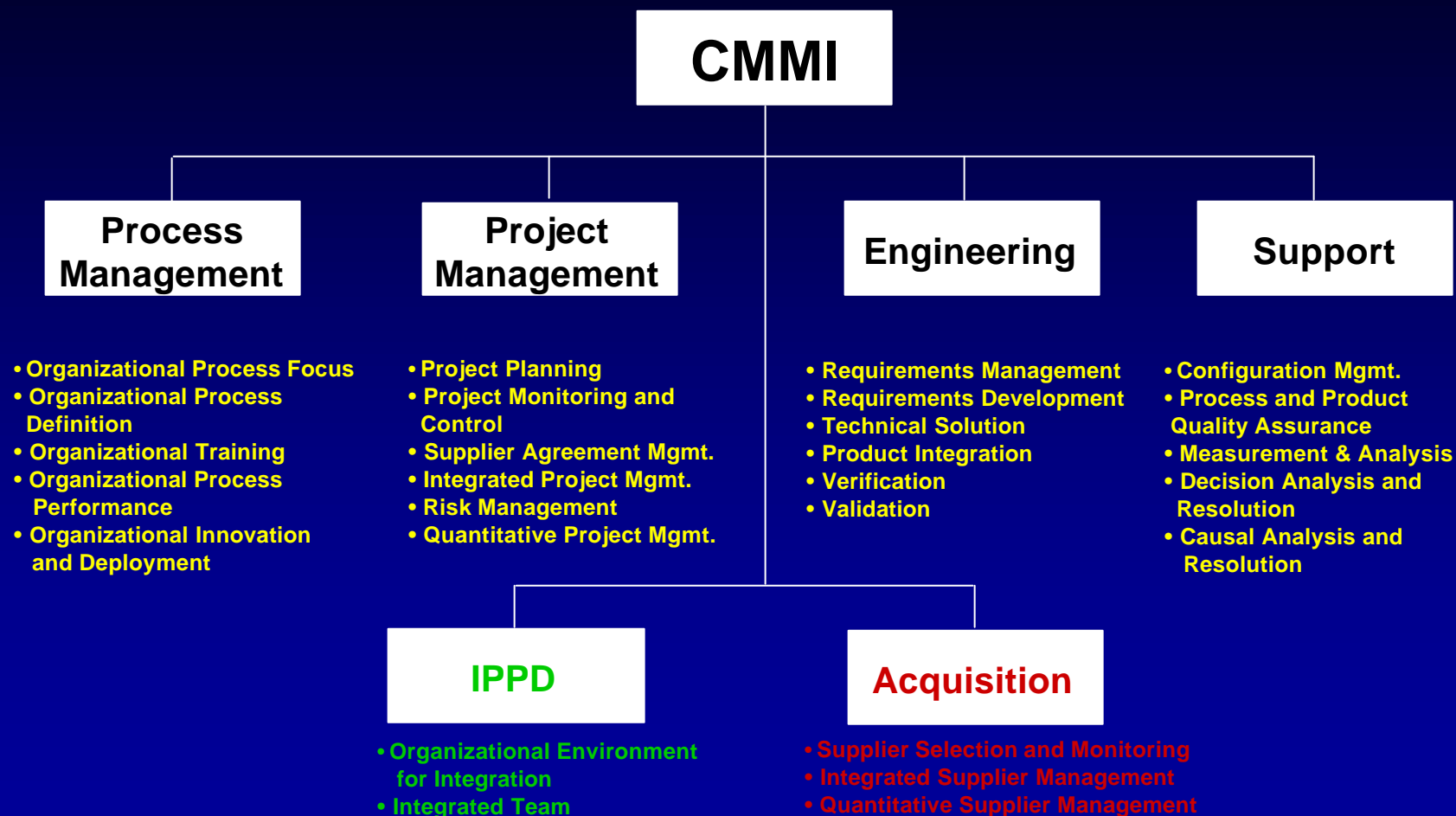


CMMI Support to DoD Acquisition



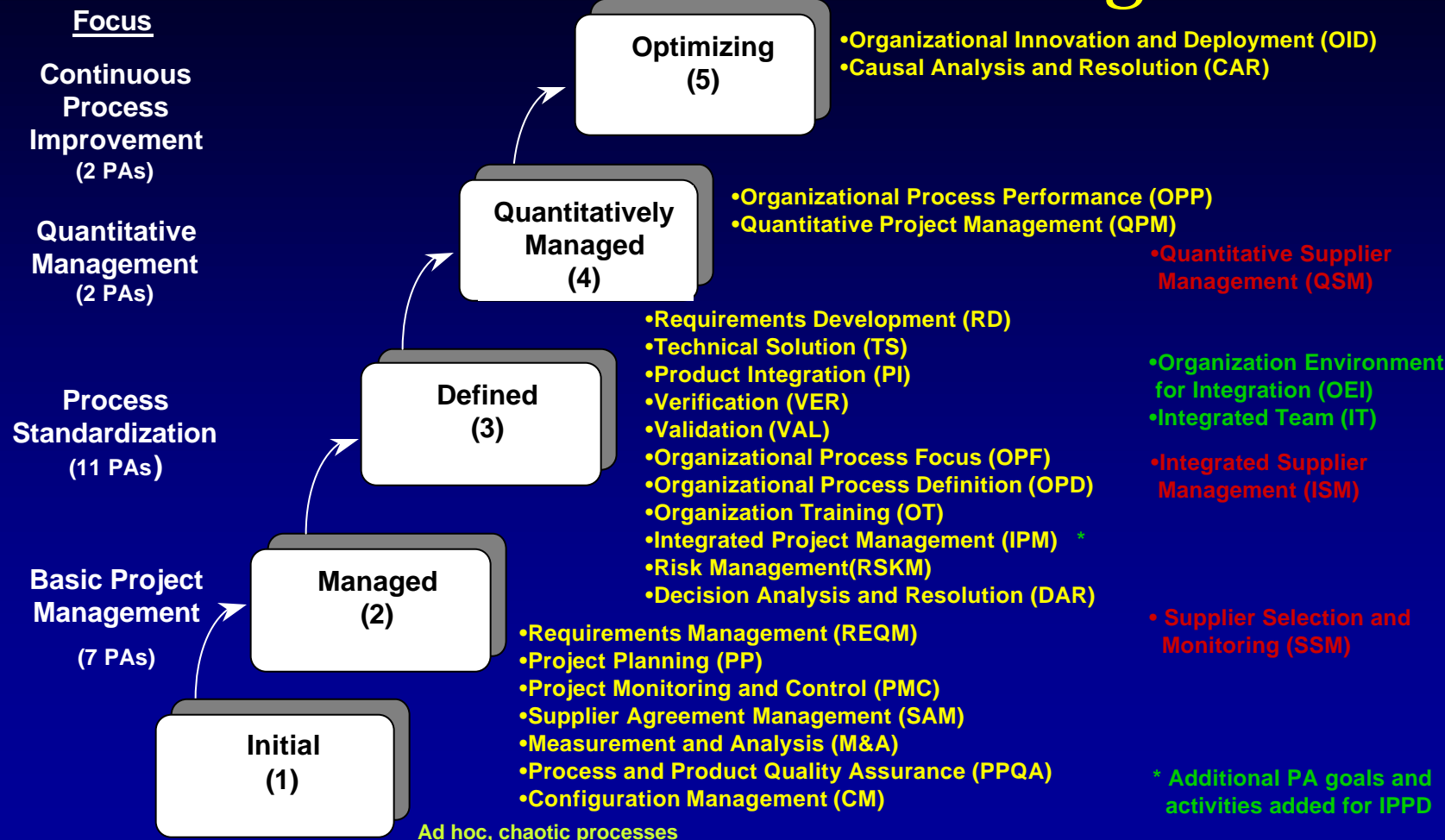


CMMI-SE/SW/IPPD/A - Continuous





CMMI-SE/SW/IPPD/A - Staged





CMMI aids organizations to ...

- ✓ *Improve delivery of promised performance, cost, and schedule*
- ✓ *Collaborate with external stakeholders and manage their expectations*
- ✓ *Provide competitive world-class products and services*
- ✓ *Implement an integrated enterprise business and engineering perspective*
- ✓ *Master system-of-systems evolutionary development complexity*
- ✓ *Use common, integrated, and improving processes for systems and software*



CMMI also aids organizations to

- ✓ *Implement proactive program management techniques*
- ✓ *Develop project leaders who look ahead and not over their shoulder*
- ✓ *Develop a staff who use best practices to cope with changing development, technology, and customer environments*
- ✓ *Enable staff to move between projects and still use the same processes*
- ✓ *Create and improve processes that adapt to a changing business environment*



CMMI is....

a process improvement method that provides a set of best practices that address productivity, performance, costs, and stakeholder satisfaction.

It is NOT

- <a set of “bolt-on processes” that last only as long as the wheel is squeaking. CMMI provides a consistent, enduring framework that accommodates new initiatives.>
- <like the SW-CMM or SE-CMM, in that CMMI focuses on the total software intensive system problem.>
- <like single-discipline models that can result in confusion and higher costs. It also facilitates enterprise-wide process improvement.>



**Capability
Level:**

Generic Goals (GG):

Generic Practices (GP):

5 (Optimizing)	Institutionalize an Optimizing Process.	Ensure continuous process improvement. Correct common cause of problems.	
4 (Quantitatively Managed)	Institutionalize a Quantitatively Managed Process.	Establish quality objectives. Stabilize subprocess performance.	
3 (Defined)	Institutionalize a Defined Process.	Establish a defined process. Collect improvement information.	
2 (Managed)	Institutionalize a Managed Process.	Establish org. policy. Plan the process. Provide resources. Assign responsibility. Train people. Perform managed process.	Manage configurations. Identify & involve relevant stakeholders. Monitor and control the process. Objectively verify adherence. Review status with mgmt.
1 (Performed)	Achieve Specific Goals.	Identify work scope. Perform base practices.	
0 (Incomplete)	(None)	(None)	



Model Metrics

<u>Release</u>	<u>PAs/ FAs</u>	<u>Goals/ Themes*</u>	<u>Activities/ Practices**</u>
SW-CMM V1.1	18	52	316
SW-CMM V2C	19	62	318
EIA/IS 731	19	77	383
IPD-CMM V0.98	23	60	865
CMMI V1.0 SE/SW	22	70	417
CMMI V1.02 SE/SW/IPPD	24	76	460

Summary values (indicated by brackets in the original image):

61	199	1566
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* Ratable components

** Key to implementation effort



CMMI & SA-CMM Mapping

CMMI PA¹

ML³ 5: Optimizing

Organizational Innovation and Deployment
Casual Analysis and Resolution

ML 4: Quantitative Management

Quantitative Project Management
Quantitative Supplier Management
Organizational Process Performance

ML 3: Defined

Integrated Supplier Management
Integrated Project Management
Organizational Process Definition
Risk Management
Organizational Training
Organizational Process Focus
Decision Analysis and Resolution
Technical Solution
Product Integration

Verification

Validation

Requirements Development

ML 2: Management

Process and Product Quality Assurance
Requirements Management
Project Planning
Project Monitoring and Control
Measurement and Analysis
Configuration Management
Supplier Selection and Monitoring

SA-CMM KPA²

ML 5: Optimizing

Acquisition Innovation Management
Continuous Process Improvement

ML 4: Quantitative Management

Quantitative Process Management
Quantitative Acquisition Management

ML 3: Defined

Contract Performance Management
Project Performance Management
Process Definition and Maintenance
Acquisition Risk Management
Training Program

ML 2: Management

Evaluation
Requirements Dev. and Management
Software Acquisition Planning
Project Management
Contract Tracking and Oversight
Solicitation
Transition to Support

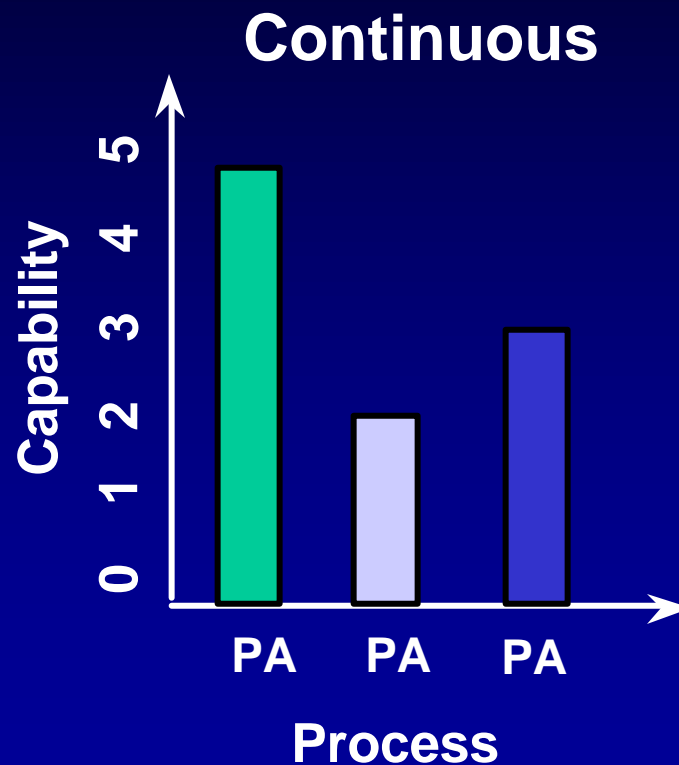
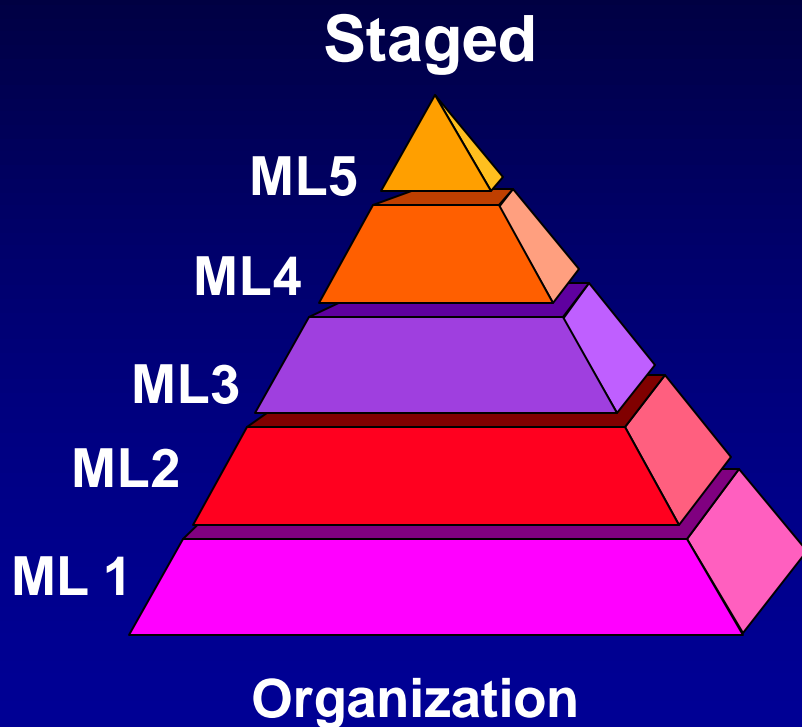
¹PA = Process Areas

²KPA = Key Process Areas

³ML = Maturity Level



CMMI Model Representations





“Process Improvement Improvement” -1

The CMMI model builds upon the legacy:

- Expanded model scope
 - Risk Management
 - Verification and Validation
 - Requirements Development and Traceability
- Better coverage of quantitative engineering management



“Process Improvement Improvement” -2

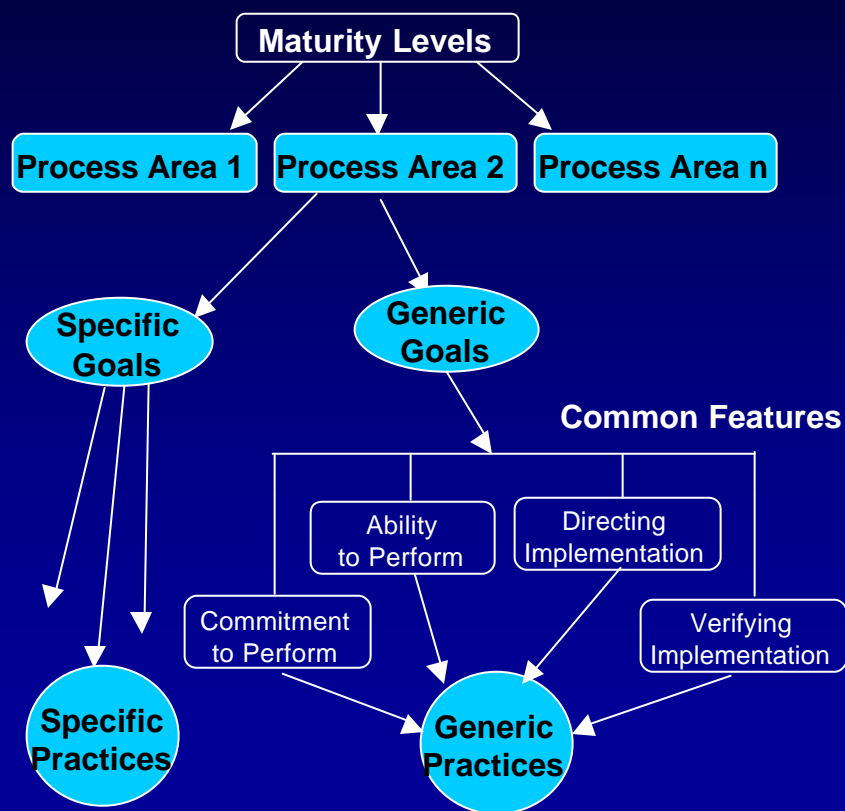
The CMMI Product Suite provides a foundation for *enterprise wide improvement* and adds:

- New emphasis on products and services as well as process
- Emphasis on both process capability and organizational maturity
- Early emphasis on Measurement and Analysis

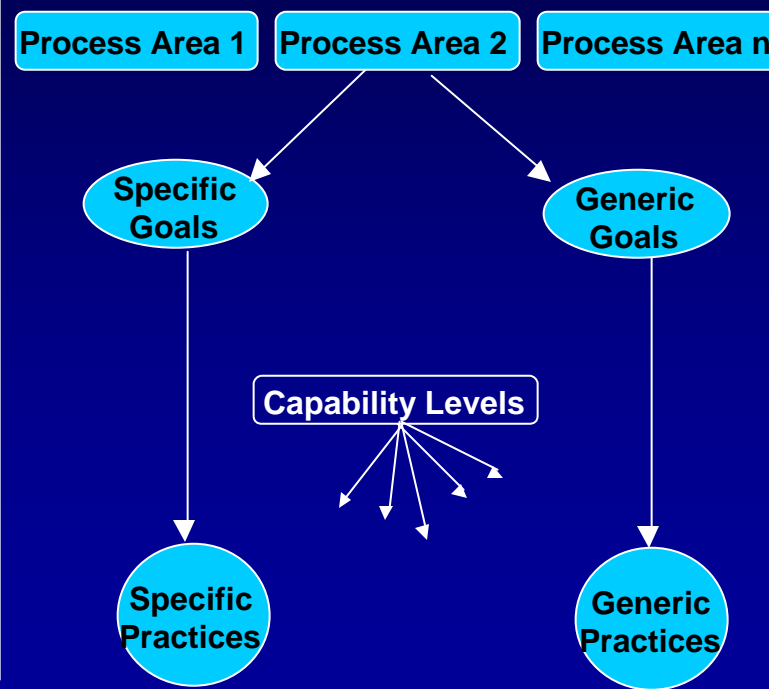


CMMI Model Structure

Staged



Continuous





CMMI Process Area Contents

Purpose

Introductory Notes

Goals: Specific and Generic

Generic Practices

Specific Practices

Notes

Work Products

Subpractices

Amplifications

Elaborations

Required

Expected

Informative

CMMI PAs in PSP and TSP

Level	Focus	Process Areas (PA)
5 Optimizing	Continuous process improvement	<ul style="list-style-type: none"> Organizational innovation and deployment Causal analysis and resolution
4 Quantitatively Managed	Product and process quality	<ul style="list-style-type: none"> Organizational process performance Quantitative project management
3 Defined	Engineering process	<ul style="list-style-type: none"> Requirements development Technical solution Product integration Verification Validation Organizational process focus Organizational process definition <ul style="list-style-type: none"> Organizational training Integrated project management Risk management Integrated teaming <ul style="list-style-type: none"> Decision analysis and resolution Organizational environment for integration
2 Managed	Project management	<ul style="list-style-type: none"> Requirements management Project planning Project monitoring and control <ul style="list-style-type: none"> Supplier agreement management Measurement and analysis Process and product quality assurance Configuration management

ö CMMI SE/SW Staged Representation Process Area addressed at the project level when using PSP and TSP



Assessment Class Attributes

<i>Attributes</i>	<i>Class A</i>	<i>Class B</i>	<i>Class C</i>
Usage Mode	<ul style="list-style-type: none">• Benchmark• Baseline establishment	<ul style="list-style-type: none">• Initial• Incremental• Self-assessment	<ul style="list-style-type: none">• Quick Look• Incremental• Gap analysis
Relative: <ul style="list-style-type: none">• Cost/Duration• Confidence• Accuracy	High	Medium	Low
Rating?	Yes	No	No

Reference: Assessment Requirements for CMMI (ARC)



Standard CMMI Assessment Method for Process Improvement (SCAMPI)

Based on CMM®-Based Appraisal for Internal Process Improvement (CBA IPI) and EIA IS 731 Appraisal Method

Satisfies all of the ARC requirements for a Class A method

Must be led by authorized SCAMPI Lead Assessor

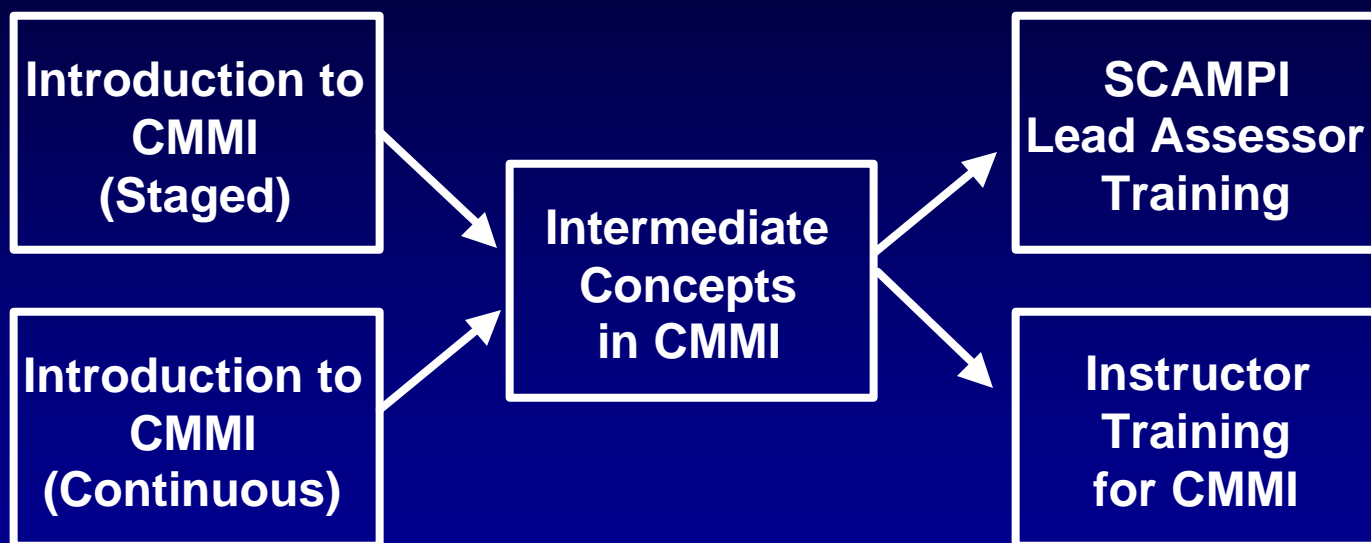
Tailorable to organization and model scope

Artifacts:

- **SCAMPI Method Description**
- **Appraisal questionnaire, work aids, templates**



Training Opportunities





SW-CMM Benefit Data

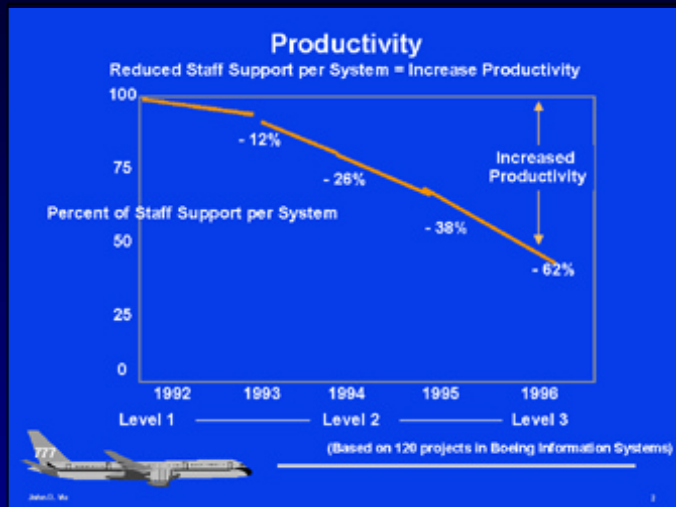
Boeing

Lockheed Martin

Motorola

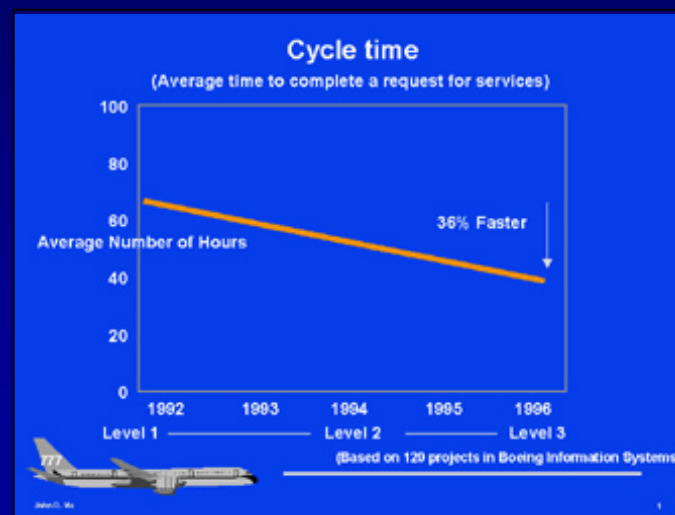


Benefits at Boeing -1



Projects operating at Maturity Level 3 increased productivity by 62%...

... while cycle times improved 36%.



Reference: Scott Griffin, Chief Information Officer, The Boeing Company, SEPG Conference, 2000.



Benefits at Boeing -2



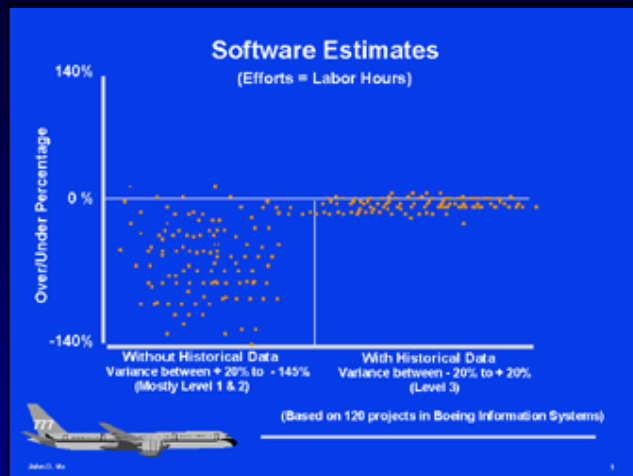
Both customer...

... and employee
satisfaction increased
with rising maturity
levels.

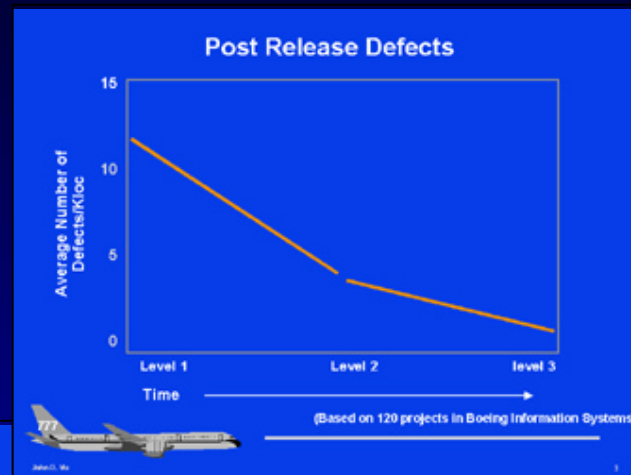




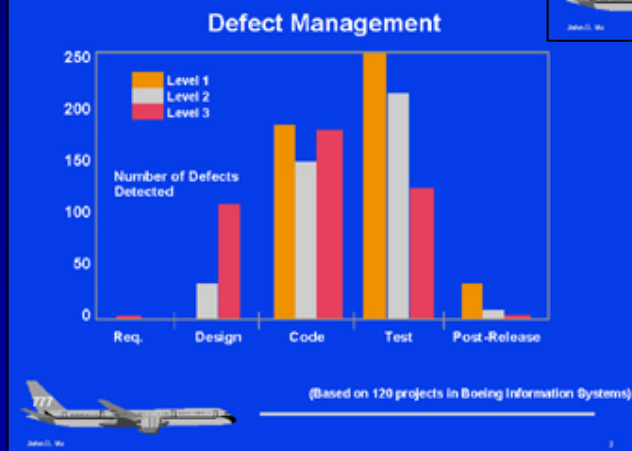
Benefits at Boeing -3



**Planning
was
more
accurate.**



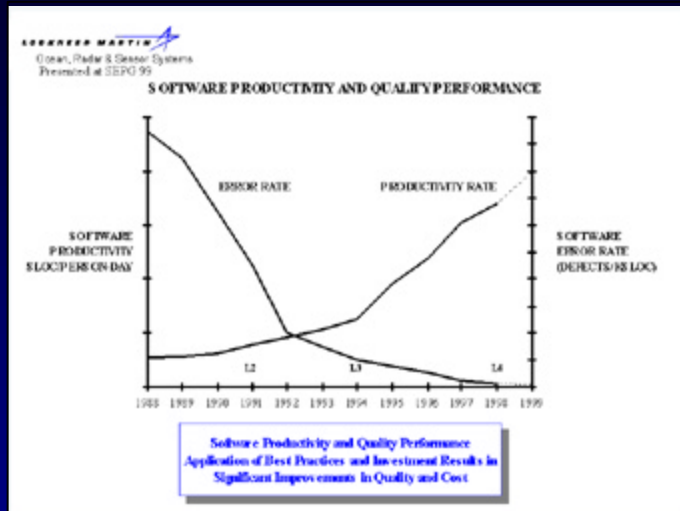
**Defects could
be detected
much earlier.**



**Product quality
increased with
rising maturity
levels.**

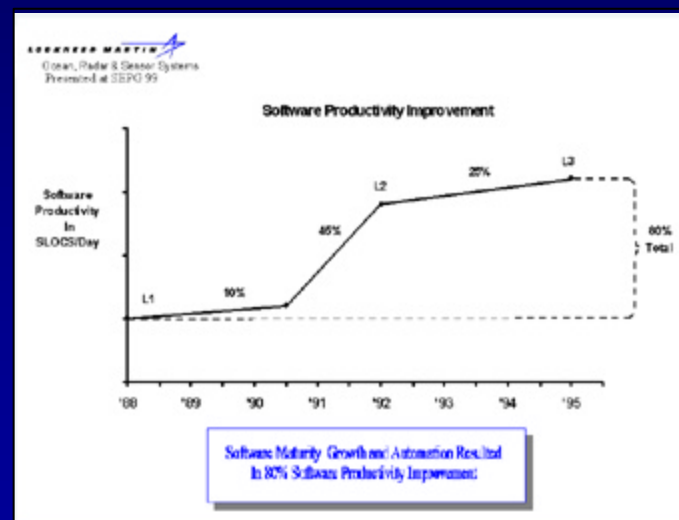


Benefits at Lockheed Martin



...productivity
increased by 80%.

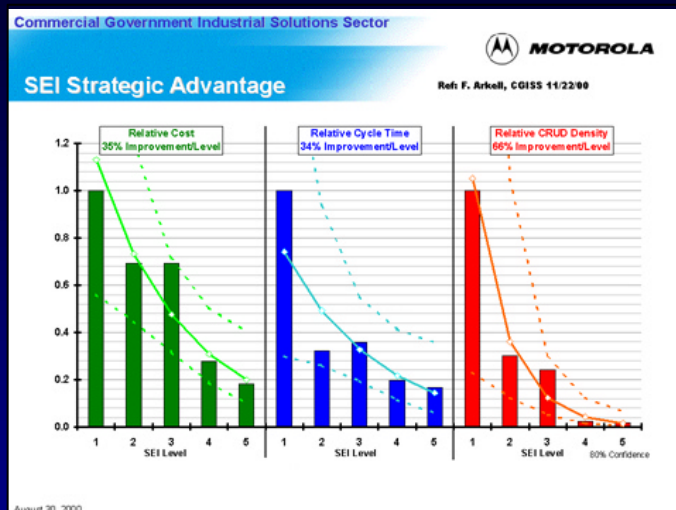
As errors declined...



Reference: SEPG Conference, 1999.



Benefits at Motorola



Quality, cycle time, and productivity improved dramatically.

Cost, cycle time, and defect density dropped sharply.

Commercial Government Industrial Solutions Sector

Results: Motorola Government Electronics Division

SW-CMM Maturity Level	Number of projects	Quality	Relative Cycle Time	Relative Productivity
1	3	n/a	1.0	n/a
2	9	890	3.2	1.0
3	5	411	2.7	0.8
4	8	205	5.0	2.3
5	9	126	7.8	2.8

Reference: Michael Diaz and Joseph Sligo, "How software process improvement helped Motorola," IEEE Software, Sept/Oct 97, p 75-81.

August 30, 2000



Anticipated Benefits at Northrop Grumman

- Extend Software Level 3 benefits to total project
 - Many projects have major non-software content
 - Therefore, the potential benefits are great
- Allow Integrated Product Teams (IPTs) to achieve their true potential
 - Integrated processes essential for effective team work

“IPT members are not functioning as a team if they play by different rules.”



Electronic
Sensors and
Systems
Sector



4

Reference: Freeman, Hinkey, and Martak, “Integrated Engineering Process,” SEPG Conference, March 1999.



Anticipated Benefits of CMMI -1

Northrop Grumman:

- Projects need more than just software process improvement
- Integrated processes essential for effective teamwork
- Repeatable SE and SW processes
- Reduction of SW errors; predictable schedules; markedly lower costs



The CMMI Product Line Approach

